

In the Claims:

The listing of claims will replace all prior versions of the claims in the application.

1. (Previously Presented) A biomolecule capture device comprising:
 - (a) a substrate having a surface; and
 - (b) a maleic anhydride compound covalently bound through a functional group at one of a molecular 2 or 3 position of the maleic anhydride to the surface of the substrate, the maleic anhydride compound having an exposed carbonyl for reversible covalent binding to a biomolecule under selected pH conditions.
2. (Original) The biomolecule capture device of claim 1, the substrate comprising a polymer having exposed reactive sites on the surface.
3. (Original) The biomolecule capture device of claim 2, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide, hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.
4. (Original) The biomolecule capture device of claim 2, the substrate comprising aminohexyl agarose or aminododecyl agarose.
5. (Previously Presented) The biomolecule capture device of claim 1, the maleic anhydride compound comprising a dialkyl maleic anhydride and derivatives thereof suitable for forming covalent bonds with the surface of the substrate.
6. (Previously Presented) The biomolecule capture device of claim 1, the maleic anhydride compound comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride and derivatives thereof suitable for forming covalent bonds with the surface of the substrate.
7. (Previously Presented) The biomolecule capture device of claim 1, further comprising a solid support to which the substrate is bound.
8. (Previously Presented) The biomolecule capture device of claim 1, the desired biomolecule comprising a biomolecule having an amine.

9. (Previously Presented) The biomolecule capture device of claim 8, wherein the biomolecule comprises a protein.
10. (Withdrawn) A method of removing and recovering desired biomolecules from a solution comprising the steps of
 - (a) contacting, under basic conditions, a solution containing one or more desired biomolecules with a biomolecule capture device comprising a substrate having a surface and one or more maleic anhydride biomolecule-binding compounds covalently bound to the surface of the substrate;
 - (b) forming one or more reversible covalent bonds between the biomolecules and the biomolecule-binding compounds, wherein the half life of binding between the biomolecule-binding compounds and the desired biomolecules is less than 1 hour;
 - (c) washing the biomolecule capture device and biomolecules attached thereto to remove unwanted biomolecules;
 - (d) exposing the biomolecule capture device to acidic conditions, thereby reversing the covalent bond between the biomolecules and biomolecule-binding compounds thereby releasing the biomolecules from the biomolecule capture device, wherein the half life of release between the biomolecule-binding compounds and the desired biomolecules is less than 1 hour; and
 - (e) recovering the desired biomolecules.
11. (Withdrawn) The method of claim 10, the desired biomolecules comprising proteins.
12. (Withdrawn) The method of claim 10, the maleic anhydride biomolecule-binding compound comprising a dialkyl maleic anhydride.
13. (Withdrawn) The method of claim 10, the maleic anhydride biomolecule-binding compound comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.
14. (Withdrawn) The method of claim 10, wherein the half life of binding between the biomolecule-binding compounds and the desired biomolecules is less than 30 minutes.
15. (Withdrawn) The method of claim 10, wherein the half life of release between the biomolecule-binding compounds and the desired biomolecules is less than 30 minutes.
16. (Withdrawn) The method of claim 10, the biomolecule capture device having a bead shape and is located in a column.

17. (Withdrawn) The method of claim 10, the desired biomolecule comprising an amine containing compound.

18. (Withdrawn) The method of claim 17, the amine containing compound comprising a protein.

19. (Withdrawn) A method of making a biomolecule capture device comprising:

(a) providing a substrate having one or more exposed reactive sites thereon;

(b) providing a dialkyl maleic anhydride;

(c) converting one alkyl group of the dialkyl maleic anhydride to a carboxyalkyl group;

(d) converting the carboxyalkyl group into a N-hydroxysuccinimidyl ester;

(e) contacting the dialkyl maleic anhydride with the substrate having the exposed reactive sites; and

(f) forming a covalent bond between the substrate and dialkyl maleic anhydride.

20. (Withdrawn) The method of claim 19, the substrate comprising the form of a bead.

21. (Withdrawn) The method of claim 19, wherein the substrate is on a solid support.

22. (Withdrawn) The method of claim 19, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide, hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.

23. (Withdrawn) The method of claim 19, the dialkyl maleic anhydride comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.

24. (Withdrawn and Previously Presented) A method of making a biomolecule capture device comprising:

(a) providing a substrate having one or more exposed amine reactive sites thereon;

(b) providing a dialkyl maleic anhydride having a N-hydroxysuccinimidyl ester at the 3 position and an alkyl group at the 2 position of the maleic anhydride;

(c) contacting the maleic anhydride with the substrate having the exposed amine reactive sites; and

(d) forming one or more covalent amide bonds between the substrate and maleic anhydride having a N-hydroxysuccinimidyl ester at the 3 position and an alkyl group at the 2 position of the maleic anhydride.

25. (Previously Presented) A biomolecule capture device comprising:
 - (a) a substrate having a surface; and
 - (b) a dialkyl maleic anhydride compound covalently bound to the surface of the substrate.
26. (Original) The biomolecule capture device of claim 25, the substrate comprising aminohexyl agarose or aminododecyl agarose.
27. (Previously Presented) The biomolecule capture device of claim 25, the dialkyl maleic anhydride compound comprising one or more of dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride and derivatives thereof.
28. (Previously Presented) The biomolecule capture device of claim 25, the substrate comprising a polymer having exposed reactive sites on the surface, each reactive site being bound to one of said dialkyl maleic anhydride compounds to provide exposed sites for covalent binding of biomolecules.
29. (Original) The biomolecule capture device of claim 25, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide, hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.
30. (Previously Presented) A biomolecule capture device comprising:
 - (a) a substrate having a surface; and
 - (b) maleic anhydride compounds covalently bound through a functional group at one of a molecular 2 or 3 position of each maleic anhydride to the surface of the substrate;
 - (c) a desired biomolecules forming a reversible amide linkage with the maleic anhydride, which linkage is reversible in less than 1 hour at an acidic pH.
31. (Previously Presented) A biomolecule capture device comprising:
 - (a) a substrate having a surface; and
 - (b) a maleic anhydride compound covalently bound to the surface of the substrate in an orientation effective for reversible covalent binding to a desired biomolecule.

32. (Previously Presented) The biomolecule capture device recited in claim 31 wherein the maleic anhydride compound is a di-substituted maleic anhydride compound.

33. (Previously Presented) The biomolecule capture device recited in claim 32 wherein the di-substituted maleic anhydride compound is a dialkyl maleic anhydride compound.

34. (Previously Presented) The biomolecule capture device recited in claim 31 wherein the maleic anhydride compound has two carbonyl portions and the orientation of the maleic anhydride compound relative to the surface of the substrate positions at least one carbonyl portion of the maleic anhydride compound for reversible covalent binding with desired biomolecules under selected pH conditions.

35. (Previously Presented) A biomolecule capture device comprising:

(a) a substrate having a surface; and

(b) a disubstituted maleic anhydride compound covalently bound at one of the disubstituted positions to the surface of the substrate in an orientation effective for controlled reversible covalent binding to a desired biomolecule.

36. (Previously Presented) The biomolecule capture device recited in claim 35 wherein the maleic anhydride compound is a dialkyl maleic anhydride compound comprising one or more of dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride and derivatives thereof suitable for forming covalent bonds with the surface of the substrate.

37. (Previously Presented) The biomolecule capture device recited in claim 35 wherein the maleic anhydride compound has two carbonyl portions and the orientation of the maleic anhydride compound relative to the surface of the substrate positions at least one carbonyl portion of the maleic anhydride compound for binding with desired biomolecules.

38. (Previously presented) A biomolecule capture device comprising:

(a) a solid support having a surface; and

(b) a maleic anhydride compound covalently bound through a functional group at one of a molecular 2 or 3 position of the maleic anhydride to the surface of the solid support, the maleic anhydride compound having an exposed carbonyl for reversible covalent binding to a biomolecule.